

Valves for gold leaching in CIL, CIP or CIC circuits

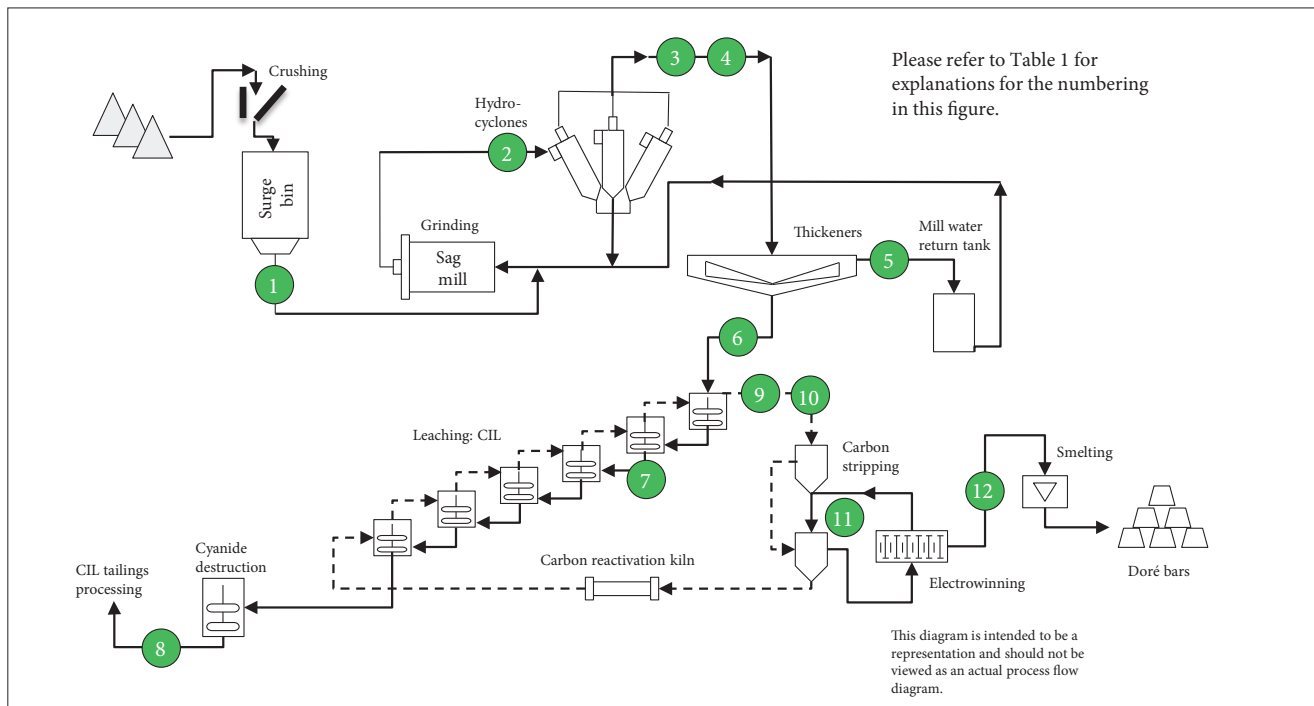


Fig. 1. Simplified representation of the gold CIL production process

Process overview

The nature and chemistry of an ore deposit determine the processing method used in gold production. For free-milling types of ores, this processing might only require comminution, followed by gravity concentration techniques, such as jigging or tabling. For more demanding ore chemistries, the processing techniques are complex and require know-how of the process variables and their cause-and-effect relationships. The most widely used processing method in gold production is cyanidation for carbon-in-leach (CIL), carbon-in-pulp (CIP) or carbon-in-column (CIC) circuits.

The gold leaching process starts with comminution. The run-of-mine ore is crushed and ground to a fine particle size. Water is added to the process to create a mud-like slurry. The slurry is then pumped into a thickener, where the gold-bearing particles sink to the bottom, where they are fed for further downstream processing.

Typically, the next step in the recovery circuit is CIL, CIP or CIC leaching. Each of these methods utilizes a cyanide solution and activated carbon to extract the gold from the slurry. The applied technology varies from plant to plant, with CIL being the most widely used processing method. In a CIL leaching circuit, a cyanide solution and oxygen are added to the slurry in large steel leach tanks. The gold dissolves from the ore into the solution. The activated carbon is fed into the process from the opposite direction, against the slurry stream. As it moves through the CIL tanks, dissolved gold adsorbs onto the activated carbon. The loaded carbon is fed into an elution column, where the adsorption process is reversed. The gold is stripped off the carbon, back into a solution called a pregnant electrolyte. This solution is then fed into electrowinning cells, where the gold is plated onto stainless steel wool cathodes. The gold sludge is removed from the loaded cathodes by water

spraying. The collected sludge is then filtered and dried. The remaining cake is mixed with fluxes and heated in a furnace to produce doré bars. The doré bars are transported to a gold refinery, where they are further processed into 99.9% pure gold.

In some cases, the gold in the ore body is refractory, requiring pretreatment before undergoing the cyanidation processing step. Typical pretreatment methods include flotation, followed by either roasting, ultrafine grinding (UFG), bio-oxidation or autoclave pressure oxidation (POx). Figure 1 presents a simplified gold processing flow sheet. The numbering in Figure 1 refers to Table 1.

Process applications

Gold leaching plants use valves for numerous flow control and isolation services. The reliability of the valves is an important concern, as their malfunction can cause safety risks and process downtime.

Several variables influence the selection of valve type, such as the requirements for tightness, resistance against abrasion and erosion, as well as pressure range, to name a few. Table 1 lists different valve applications in the gold leaching process and shows typical valve types used in each of the various processing steps. Selected valve applications in gold leaching are further discussed in the next chapters.

Table 1. Typical valve types by application in gold production.

Nr.	Application	Typical valve types
1	Surge bin	Gate, globe and diaphragm valves
2	Cyclones	Knife gate and butterfly valves
3	Pump isolation	Butterfly and knife gate valves
4	Slurry	Process ball, pinch, sleeved plug and knife gate valves
5	Thickening overflow	High-performance butterfly, resilient seated butterfly and knife gate valves
6	Thickening underflow	Pinch and knife gate valves
7	CIL tanks	Process ball, sleeved plug, gate and globe valves
8	Tailings / paste fill	Butterfly, ball, diaphragm, pinch and knife gate valves
9	Loaded carbon	Knife gate valves
10	Acid washing	Butterfly, ball, knife gate and diaphragm valves
11	Pregnant leach solution	Butterfly and knife gate valves
12	Mechanical filter press	High-performance butterfly, process ball and pinch valves

Valves for thickening

Thickeners increase the solids content and thus the gold concentration of the slurry. Unwanted gangue is separated in the thickener and processed in the tailings stream. The process water is recycled back for upstream processing.

Valve installations in thickeners are needed for the overflow as well as the underflow service. On the overflow side of the process, butterfly valves provide very effective flow control. Knife gate valves are also utilized in this application. For the thickener underflow, pinch and knife gate valves are the most typical solutions.

Valves for pressure oxidation (POX)

If the gold ore is refractory by nature, it may require a pretreatment processing step before the leaching takes place. One pretreatment option is pressure oxidation.

The conditions that valves face in the POX process require the highest possible resistance against corrosion and erosion, as well as deterioration caused by solid contents. To maintain the sealing abilities of slurry feed valves, the right material, seat and coating choices play an important role.

Valves for the leaching tanks

Regardless of the leaching method – carbon-in-leach (CIL), carbon-in-pulp (CIP) or carbon-in-column (CIC) – valves need to provide reliable control for the liquid, gaseous and air flows. The presence of cyanide poses challenges to the process control and makes correct valve material selection essential.

When performance requirements are a high priority, process ball valves are a good option for the leaching tanks. With the right material, coating and seat selection, ball valves provide long service life, accompanied with precise flow control capabilities.

Process challenges

- Protection against abrasive solids content in the slurry needs to be carefully taken into consideration
- Valve material and coating selections are challenged by the presence of hazardous chemicals, such as cyanide
- Valves must provide safety and reliability in isolation and control service from a design point of view, along with ensuring long-term tightness in continuous operation

Neles solutions

Gold leaching is a demanding operation in which optimization of the process flow has the potential to provide substantial savings for the plant. In addition to our wide portfolio of mining equipment, we are proud of our status as a global leader in flow control solutions. With over a century of experience in the mining sector, Neles valves are the optimal solution for efficient and safe gold processing plant operation.

Valves

The selection of valve type depends on the process design conditions as well as a customer's preferences and specifications. Our experts are dedicated to finding the most economical solution, providing superior safety and the lowest total cost of ownership.

Neles Neldisc triple eccentric butterfly valves are a field-proven and economical solution. Gold processing plants use these valves, for example, in pump isolation, elution circuits, as well as in electrowinning applications.

Major benefits include:

- Reliable and low maintenance due to simple construction
- Small outline and low weight, resulting in savings in both valve and piping costs
- Low operational torque, reducing wear and actuator size
- Robust and heavy-duty stem and bearings, which excel in providing a long service life



Neles butterfly valve

For processing steps, such as flocculent addition, leaching tanks and acid washing, Neles ball valves provide an excellent solution. Application-based seat selection ensures that our valves can deliver tightness even in the most demanding applications, including abrasive fluids and solids handling. Valve modularity widens the options in material selections to meet the specific requirements for each application. Our valves meet and exceed modern industry requirements for reliability, performance and safety.



Neles ball valve

We supply gold processing plants with a wide range of valve products – from butterfly valves to ball valves to knife gate valves and more. For decades, we have developed and tested materials and technology in metal- and soft-seated valves. We are a leading supplier of valve solutions for severe service and demanding process environments. Our valves can resist abrasive particles in flow mediums and maintain valve cycle life and tightness for long service intervals. Our portfolio of actuators, valve control and instrumentation ensures that our customers get the full package and a single source of supply for their flow control needs.

Benefits

- Improved process control, increasing product yield and profit
- Field-proven valve operation
- Compliance with the most stringent reliability and safety requirements
- Forerunner in material technology for valve body materials
- Minimized unexpected shutdowns
- Simple valve instrumentation, together with higher safety integrity and better reliability
- Reliable valve operation, even in conditions with high solids content due to non-clogging valve designs

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